What is claimed is:

1. A method of forming a transferring surface onto a producing die to produce an optical element, wherein the transferring surface transfers an optical surface onto the produced optical element, the method comprising the steps of:

cutting a material so as to form the transferring surface with a curvature;

wherein the material has a hardness not smaller than Rockwell hardness HRA 80 or Vickers hardness Hv 1000 and the cutting step is conducted with a critical cutting-in depth of 5 μm or less for the material.

2. The method of claim 1, wherein in the cutting step that a cutting edge of the cutting tool and the material are relatively brought in contact with each other at a cutting point, the cutting step is conducted while the cutting point of the cutting edge is continuously shifted along the cutting edge of the cutting tool.

3. The method of claim 1, wherein in the cutting step that a cutting edge of the cutting tool and the material are relatively brought in contact with each other at a cutting

point, the cutting step is conducted while the cutting point of the cutting edge is fixed at a point of the cutting edge of the cutting tool.

4. The method of claim 1, wherein in the cutting step that a cutting edge of the cutting tool and the material are relatively brought in contact with each other at a cutting point, the cutting step is conducted while the cutting edge of the cutting tool is kept with an angle within a range of ±15 degrees.

5. The method of claim 1, wherein the transferring surface is an aspherical surface.

6. The method of claim 1, wherein the transferring surface has an effective diameter of 5 mm or less.

7. The method of claim 1, wherein the cutting edge of the cutting tool comprises a diamond.

8. The method of claim 7, wherein the transferring surface of the material is shifted relatively to the cutting edge of

the cutting tool comprising the diamond in a direction predetermined on a basis of a crystal orientation of the diamond.

9. The method of claim 8, wherein the cutting edge of the cutting tool comprises a rake face facing forward in a cutting direction and a flank facing backward in the cutting direction for the transferring surface to be cut, and wherein a (110) surface of the diamond is used as the rake face and the cutting step is conducted while the transferring surface is shifted relatively to the rake face along another (110) surface of the diamond extended in a direction intersecting with the rake face.

10. The method of claim 8, wherein the cutting edge of the cutting tool comprises a rake face facing forward in a cutting direction and a flank facing backward in the cutting direction for the transferring surface to be cut, and wherein a (110) surface of the diamond is used as the rake face and the cutting step is conducted while the transferring surface is shifted relatively to the rake face with an angle within a range of $\pm$15 degrees for another (110) surface of the

diamond extended in a direction intersecting with the rake face.

11. The method of claim 8, wherein the cutting edge of the cutting tool comprises a rake face facing forward in a cutting direction and a flank facing backward in the cutting direction for the transferring surface to be cut, and wherein a (110) surface of the diamond is used as the rake face and the cutting step is conducted while the transferring surface is shifted relatively to the rake face along a (100) surface of the diamond extended in a direction intersecting with the rake face.

12. The method of claim 8, wherein the cutting edge of the cutting tool comprises a rake face facing forward in a cutting direction and a flank facing backward in the cutting direction for the transferring surface to be cut, and wherein a (110) surface of the diamond is used as the rake face and the cutting step is conducted while the transferring surface is shifted relatively to the rake face with an angle within a range of $\pm$15 degrees for a (100) surface of the diamond extended in a direction intersecting with the rake face.

13. The method of claim 8, wherein the cutting edge of the cutting tool comprises a rake face facing forward in a cutting direction and a flank facing backward in the cutting direction for the transferring surface to be cut, and wherein the cutting step is conducted while the transferring surface is shifted relatively to the rake face along a (111) surface of the diamond.

14. The method of claim 8, wherein the cutting edge of the cutting tool comprises a rake face facing forward in a cutting direction and a flank facing backward in the cutting direction for the transferring surface to be cut, and wherein the cutting step is conducted while the transferring surface is shifted relatively to the rake face with an angle within a range of ±15 degrees for a (111) surface of the diamond.

15. The method of claim 8, wherein the rake face of the cutting edge has a rake angle within a range of ±15 degrees.

16. The method of claim 8, wherein the transferring surface is relatively rotated to the cutting edge of the cutting tool on a plane including the cutting point and the optical axis.

17. The method of claim 8, wherein the transferring surface has an angle of a normal line of 30 degrees or more.

18. The method of claim 8, wherein the cutting step is conducted with a hyper precision processing machine having a control resolving power of 100 nm or less for a shaft to hold one of the cutting tool and the transferring surface.

19. The method of claim 18, wherein the hyper precision processing machine has a moving section has 3-axes or more.

20. The method of claim 18, further comprising:

measuring the shape of the transferring surface formed by the cutting step;

obtaining deviations between the measure shape and an ideal shape; and

cutting again the transferring surface on the basis of the obtained deviations while shifting the transferring surface relatively to the cutting tool.

21. The method of claim 20, further comprising:

obtaining an error component of each item of the polynomial of Zernike on the basis of the deviations; and

judging the quality of the shape of the transferring surface by comparing the error component with a predetermined value.

22. The method of claim 20, wherein the producing die having the transferring surface is mounted on a rotating shaft of a processing machine to conduct the cutting step, and the measuring step is conducted without dismounting the producing die from the rotating shaft.

23. The method of claim 1, wherein the producing die is a producing die to form an optical element from a plastic material and the transferring surface transfers an optical surface onto the optical element.

24. The method of claim 1, wherein the producing die is a producing die to form an optical element from a glass material and the transferring surface transfers an optical surface onto the optical element.

25. The method of claim 1, wherein at least the material of the transferring surface of the producing die to be cut is hyper hard.

26. The method of claim 1, wherein at least the material of the transferring surface of the producing die to be cut is a ceramic.

27. The method of claim 26, wherein the ceramic is a silicon carbide.

28. The method of claim 27, wherein the ceramic is a silicon carbide formed by chemical vapor deposition (CVD).

29. The method of claim 1, further comprising:

polishing the transferring surface after the cutting step.

30. A processing apparatus used for the method of claim 1.

31. An optical element producing die formed by the method of claim 1.